Proceedings of the 9th Annual Meeting Of the Canadian Eel Science Working Group (CESWoG) November 29-30, 2011, St. Lawrence Centre (Salle Lamontagne), Montreal, QC

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PROCEEDINGS OF THE 9TH ANNUAL MEETING OF THE CANADIAN EEL SCIENCE WORKING GROUP (CESWOG) NOVEMBER 29-30, 2011, ST. LAWRENCE CENTRE (SALLE LAMONTAGNE), MONTREAL, QC

Edited by

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ABSTRACT

DFO. 2012. Proceedings of the Ninth Meeting of the Canadian Eel Science Working Group, 29-30 November, 2011, Montreal, QC Can. Tech. Rep. Fish. Aquat. Sci. 3043: iii + 27 p.

The Canadian Eel Science Working Group (CESWoG) met for the ninth time on November 29-30 in Montreal, Quebec. The purpose of the meeting was to share information on the American Eel (*Anguilla rostrata*) relevant to new and emerging issues in eel science. The meeting participants included representatives from: Fisheries and Oceans Canada (DFO) Science, DFO Fisheries Management, Parks Canada, Provinces of Quebec and Ontario, Aboriginal groups, academics, students, Ontario Power Generation, and the eel industry. A list of participants is given in Appendix 2.

CESWoG PROCEEDINGS

Introduction

The 9th meeting began with the recognition of Geoff Veinott, Fisheries and Oceans Canada (DFO) as co-chair over the last two years and the welcoming of Tom Stewart, Ontario Ministry of Natural Resources in his first year as co-chair. It was noted that Keith Clarke (DFO) has agreed to be co-chair for the next two years. It was noted that DFO no longer provides support for the publishing of proceedings under the Canadian Science Advisory Secretariat (CSAS) and that other options would be considered for publishing and making the proceedings accessible. There were questions about the status of the Canadian Eel Working Group (CEWG) which had not met for sometime. Although management issues regarding the status and recovery of eels were the context for this CESWoG meeting, the main purpose of the meeting was to share information and focus on eel science. It was agreed that it was appropriate for CESWoG to request that CEWG be re-invigorated to facilitate discussion of eel management issues and that the terms of reference of CESWoG be endorsed by CEWG. Rapporteurs for the meeting were Alastair Mathers, Martin Castonguay, David Cairns and Carolyn Bakelaar. The agenda for the meeting is in Appendix 1.

Presentations

Spatially varying phenotypic plasticity and genotype selection within panmixia: Relevance for the conservation of the American Eel

Caroline L. Côté[1], Pierre-Alexandre Gagnaire, Martin Castonguay[2], and Louis Bernatchez[1]

[1]Institut de Biologie Intégrative et des Systèmes (IBIS), Université Laval, QC, G1V 0A6

[2] Institut Maurice-Lamontagne, Ministère des Pêches et des Océans, 850 Route de la Mer, Mont-Joli, QC, G5H 3ZH.

Abstract

The American eel (*Anguilla rostrata*) is an economically important species but the efficiency of its management has been compromised by incomplete knowledge of the factors influencing its distribution and abundance in the various habitats it occupies. Yet, recruitment in the upper part of the St. Lawrence River and Lake Ontario has declined by 99% over the last 30 years while in more coastal waters of the Gulf of St. Lawrence, abundance indices have tripled during the same time period. This still unexplained paradox is puzzling to provincial and federal agencies responsible for the conservation of American eel. In this context, this

presentation will report on results pertaining to 3 main research objectives: i) Document the geographic pattern of genetic population structure of the American eel by means of molecular makers to rigorously test the null hypothesis of panmixia between eel from the upper St. Lawrence River and Lake Ontario versus other parts of the species range; ii) Test the null hypothesis of no genetically-based phenotypic and gene expression differences under controlled conditions between eels from two different locations; iii) Test for evidence of selection acting on functional genes among localities. The results of this 4 year study strongly suggests that there are quantitative genetic differences between glass eels colonizing different parts of the distribution range despite the fact that they all belong to a single panmictic population. Plausible explanations for this pertain to either non random dispersal based or selective mortality based on individual genetic differences. The relevance of these findings is two-folds. On the one hand, evidence for panmixia justifies the need for global coordinated actions towards improved management and conservation of eel. On the other hand, evidence for local, genetically based, phenotypic differences also justifies the need for local actions. These observations call for particular management and conservation measures that may be unique to eel.

Discussion

Question: How can the differences in sex ratio be explained with current explanation?
Response: Strong maternal effect on rearing location...

Either differential mortality or differential dispersal could explain result observed. A paper summarizing the result will be published in early January and a draft will be circulated.

Two Proposed DUs for the COSEWIC Status Report - Update

Valérie Tremblay, AECOM, Fusey Trois-Rivieres, QC, G8T 2T1

Abstract

At the Draft Report for this COSEWIC Status Report-Update, only 1 Designatable Unit (DU) was considered, along with panmixia. However, an inquiry for two DUs from the COSEWIC Subcommittee Co-Chairman has forced the establishment of two DUs for the Provisional Report: 1) Great Lakes and St. Lawrence River; 2) Gulf of St. Lawrence and Atlantic Provinces. This is based on the area of occupancy within different freshwater biogeographic zones (NFBZs), and on some evidence of genetic differences. According to Bernatchez et al. (2011), within a context of panmixia, a significant genetic difference in growth between geographic areas could be reflecting non-random dispersal or habitat selection, or differential mortality associated with individual genetic variation. Since the identification of two DUs is a proposal and that the Provisional Report has just

been sent for 6 month review, this needs to be discussed, in terms of COSEWIC *Guidelines* but also in terms of observed effort to reduce overall mortality.

Discussion

Valerie reminded the group that the information regarding DU's for eel is confidential and that no final decisions have been made. The proposal for 2 DU's is a straw dog that will be reviewed by COSEWIC. The COSEWIC guidelines for the development of DU's do not fit the life-history of the American eel very well

Fish Enhancement, Mitigation and Research Fund (FEMRF) American Eel Efforts (unscheduled presentation)

Scott Schlueter U.S. Fish and Wildlife Service, New York Field Office, Cortland, NY, 13045

Abstract

No abstract provided for this presentation

Discussion

There is a $24 million research fund that is oriented to eel passage at hydro dams. In particular, there is interest in the Iroquois Dam on the St. Lawrence River. This is the narrowest constriction in the area. There are no turbines in the dam. No ship navigation issues. A plan was outlined for a test of whether eels can be captured at the Iroquois dam, for purposes of transportation downstream around the other dams. The plan calls for a regulatory review, detailed current and depth mapping, assessment of the effects of debris loading on fish guiding gear, testing tracking technologies, testing small-scale light arrays combined with sound and vibration, testing of the collection device consisting of an inclined screen, implementation of the prototype guidance system, and implementation of a full-scale guidance system. NYPA is looking for partners in this work. In the past, NYPA has funded Ken Olivera's work on Anguillicola crassus.

Ken Oliveira described the plan to examine the energy content of downstream migrating eels. There will be an attempt to measure lipid content non-lethally. There will be a detailed review of energy reserves in eels, and a comparison of the energy content of stocked vs. natural eels, and parasitized vs. non-parasitized eels. Sampling sites will include a heavily parasitized male-dominated stream, Beauharnois Dam, and Nova Scotia.

The 12-month status review will not begin until FY 2013. The deadline of Nov 28, 2011 is likely no longer applicable (for scientific advice at least). Contact Martin Miller, USFWS, 413 253-8615 (or can contact Scott Schlueter initially). They are looking for new information since the 2007 status review.

2011 Moses-Saunders Dam Eel Ladder (NY and Ontario Results

Ben Lenz, New York Power Authority, 123 Main St # 1600 White Plains, NY, 10601

Abstract

No abstract provided for this presentation

Discussion

This year the largest number of upstream migrants (51K) in the past decade was observed. Faster recorded upstream travel times from Beauharnois to Moses Saunders than observed in the past. There are lots of technical differences between the OPG and the NYPA ladders. Models could be used to predict the numbers of eels moving upstream based on environmental conditions (moon phase, temperature, etc.) The numbers of eels is increasing but still very low relative to 70s and 80s. There were some stocked eels ~2% (based on past work)

Question: What factors determine which ladder is used?
Response: Time of operation (US ladder starts somewhat later), water flows, numbers of turbines in operation, lots of factors – some may not be well understood
Question: Use of ship locks by eels
Response: No evidence when NYPA looked at locks during late 1990s. Before the development of the OPG ladders eels were accumulating below the dam and there may have been more incentive to use the locks.

2011 Eel Ladder Results in Quebec (Beauharnois and Chambly)

Jean Caumartin, Hydro Québec, 75 Boul. Rene Levesque Ouest Montréal, QC

Abstract

No abstract provided for this presentation

Discussion

Waters of Richelieu River are very turbid relative to SLR – which may have an influence on the effects of moon phase on upstream migration.

Impact of Beauharnois and Chambly eel ladders on upstream migrants demography

Guy Verreault, Ministère des Ressources naturelles et de la Faune, QC

Abstract

No abstract provided for this presentation

Discussion

Question: How does size at age compare for stocked eels vs. natural migrants?
Response: Very large variation in the growth of stocked eels relative to the growth of natural migrants.

Migrating silver eels originating from stocking program: are they a real benefit for the stock?

Guy Verreault, Ministère des Ressources naturelles et de la Faune, QC

Abstract

No abstract provided for this presentation

Discussion

Author wanted to know if migrating silver eels that originate from stocking are of a real benefit to the stock. Since 2005, more than 7,000,000 glass eels and elvers have been stocked in the upper St. Lawrence area. All were batch-marked in oxytetracyline.

Captures of silver eels in the St. Lawrence estuary, that were of stocked origin:
2009: 30 fish
2019: 200 fish
2011: 360 fish

Mean length of naturally-recruited silver female: 950 mm. Stocked silver eels: 664 mm. The mean length of stocked eels caught as silvers has not increased over the 3 years. Mean fecundity of these eels, termed "small matures," is about 6 million eggs. For naturally recruited silvers, fecundity is 14 million. However, production per year from stocked eel cohorts may actually be higher than for natural recruits, because stocked eels mature in a much shorter time. Also, turbine mortality is likely lower for stocked eels because they migrate at a smaller size.

Sex ratio of migrating stocked silver eels is uncertain because males are too small to be caught in estuary traps. Stocked eel catches in St. Lawrence estuary traps peak 10 days later than naturally recruited eels.

There is a broad team working on a variety of issues related to stocked eel production. Topics covered include ocean tracking, genetics, fecundity, and aging. It is not yet possible to draw conclusions on the contribution of stocked eels to the population.

Telemetry: About 60 stocked eels have been fitted with pingers. The Cabot Strait acoustic receiver line will tell us if these eels found the exit of the Gulf. May be detected by the OTN

There may be some large silver eels in Nova Scotia. These eels may be larger than silver eels of stocked origin that are captured in the St. Lawrence Estuary In some rivers where glass eels were collected for stocking the silvers are larger than 80 cm..

Comment: Sex ratio may be better measured in Lake Ontario from boat electrofishing, than from St. Lawrence estuary traps.

Question: How will the eel's plasticity be expressed?
Response: Stocked eels seem to migrate at a much smaller size. Could be differences in growth of stocked eels
Question: Fat content measured?
Response: Fat content was measured by Catherine Couillard.

OPG Stocking and Effectiveness Monitoring

Tom Pratt[1], Ron Threader[2], and Catherine Couillard[3]

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[2]Ontario Power Generation, PO Box 950, 2 Innovation Drive, Renfrew, ON
[3]Fisheries and Oceans Canada, Mont-Joli, QC

Abstract

Precipitous declines in the recruitment of American eel to formerly productive habitats in the Upper St. Lawrence River and Lake Ontario resulted in the implementation of an experimental American eel conservation stocking program. Over 4 million American eels were stocked in 2006 through 2010 in the St. Lawrence River near Mallorytown Landing, and in the Bay of Quinte near Deseronto. Assessments indicate a rapid increase in abundance from the first survey in the spring of 2009 to the spring of 2011, with an apparent leveling off or

slight decrease by the fall of 2011. Densities of stocked eels are fairly consistent among the two main stocking locations, with approximately 90 eels/ha captured in the spring, and 50 eels/ha in the fall, at the two locations. Rapid growth of approximately 100 mm/yr was also observed in both locations. Around 40% of the eels assessed for gender in both 2009 and 2010 were male. Monitoring of the stocked eels will continue for at least three more years.

Discussion

There is a trap and transport component and a stocking component. Stocking requires various approvals for health. A new health screening protocol was devised. Holding in quarantine for a long time may increase mortality. There has been no stocking since 2011. Stocking has taken place in the Thousand Islands and in the Bay of Quinte. Original hypothesis was that eel life histories are shaped by habitat, so that the normal St. Lawrence River life history would be recreated in stocked eels. Densities are measured in nightime boat electrofishing, using 100 m transects. Spring densities have increased from 2009 to 2011. Densities are more variable in fall. Growth is rapid growth, ca 100 mm/year. Biomass density is increasing as eels grow. There is no evidence of spinal damage due to boat electrofishing. A substantial portion of stocked eels are male. Eels have survived and dispersed well. Stocked eels do not recreate the life history patterns of naturally occurring eels in Lake Ontario.

Tom Pratt (separate talk): Will trap and transfer programs, and eel stocking, contribute to recruitment of St. Lawrence River American eel?

Movements of stocked eels, and eels which were trapped and transported were followed by use of PIT tags. Condition of captured eels was also examined. Trapped and transported eels have the same silvering stage and gonad maturation stage as naturally-recruited eels. However, stocked eels are at an earlier silvering stage and earlier gonad maturation than naturally-recruited eels.

Measurements of fat reserves, and modelling of energy needs, indicates that most naturally recruited eels have enough reserves to reach the Sargasso Sea and spawn successfully. In contrast, most stocked eels do not have enough fat reserves to reach the Sargasso Sea and spawn successfully.

Trap and transport appears to be an effective conservation measure. Stocking looks less viable as a conservation measure, because stocked eels may not be able to successfully spawn.

Question: European silver eels are smaller than St. Lawrence silver eels, but they reach the Sargasso Sea and spawn. How do you explain this?
Response: Naturally-recruited eels that rear in the Northwestern Gulf of St. Lawrence are about the same size as silver eels as stocked eels. Silver eels descending the St. Lawrence can first ride downstream currents, and then use

selective tidal transport to go to the mouth of the estuary. All this takes very little energy. If the model says that stocked eels can't reach the Sargasso Sea and successively spawn, how can natural eels from the Northwest Gulf do it?

Comment: The model is based on fat. You need to consider fat reserves, not just size.

Comment: Energy reserve modelling must be considered in the context of a larger life history and mortality pattern.

Question: Large variability in growth of stocked eels – could this be males vs. females?
Response: Sample sizes small but will do this in the future.

Comment: Highly variable growth of stocked eels. Some eels may stay in growth habitat for a longer period of time. European silver eels are smaller than SLR silvers, but they seem to be able to spawn successfully. Lipid reserves may be very important to determining the contribution of silver eels to the global spawning success – this is particularly important for stocked eels.

A historical abundance index of eels in the St Lawrence River

Yves deLaFontaine, Environment Canada, Aquatic Biodiversity, 105 McGill Street, Montréal, QC, H2Y 2E7

Abstract

No abstract provided for this presentation

Discussion

Applied multiplicative model to CPUE of estuary trap-nets in the Quebec City area. Looked for correlations with water temperature, discharge, and North Atlantic Oscillation. Used Spearman correlation with appropriate lags. This work was published in 2010. The paper showed a declining index since the early 1960s, and no hydroclimatic influence on CPUE. The data are re-analyzed and extended with data on landings and the number of active fishers. A combined index was calculated, in which 60% of the variation was due to year effects. Temperature in the St. Lawrence was stable until 1960; thereafter it increased. Water levels have decreased since the 1920. Water levels influence the amount of shallow fish habitat. There is a correlation of CPUE with annual discharge. Other hydrological factors were not correlated. CPUE increased in the 1950s, but then declined starting in the early 1960s.

Question: Did you try a variety of analyses for the NAO?
Response: We tried a great variety of indexes.

Question: Did you say that CPUE of migrating adults started declining before the recruitment failure in the upper St. Lawrence?
Response: St. Lawrence is an important component of spawn production. This would explain the fact that the CPUE decline came before the Moses-Saunders recruitment decline. Landings are a poor indicator of abundance.

Question: What is the scale of reduction of CPUE?
Response: Scale of reduction is much less than at Moses-Saunders. Landings have dropped because of changes in effort.

Comment: There seemed to be widespread problems in 1960s, not just in eels.

Comment: There was intense industrialization in the 1960s, including chemical loading. We are now losing fishing activity, on which this index is based.

Question: How was the early part of series calculated?
Response: It was based on active fishers (not weirs) and landings. The first 5 years of the series is probably not reliable. But the increase in the series from the late 1950s to early 60s is probably valid.

Question: Which NOAA index used?
Response: Tried 4 different indices, but none were related to the decline

Comment: Decline from 1960s was a result of an increase in mortality from multiple sources. This would suggest that SLR portion is an important component of the population. Scale of reduction in CUE is much less than the decline in the Saunders eel ladder index. Industrialization also occurred during the 1960s. Lots of contaminants (e.g. atrazine) came into common use during the 1960s. There is a period during the late 1950s which suggest that the CUE was increasing.

Dispersal of Stocked American Eel into Lake Ontario Tributaries: Influence of Dams and Watercourse Size.

Scott Reid, Ontario Ministry of Natural Resources, 2140 East Bank Drive, DNA Building. Trent University 2 Floor, B305, Peterborough, ON, K9J 7B8

Abstract

No abstract provided for this presentation

Discussion

Wanted to develop a sampling protocol for eels in tributaries. Compared point vs. transect sampling. Transect sampling was found to be generally superior to

point sampling. Eels are widely distributed in numerous tributaries of the Bay of Quinte, especially lower reaches. Dams on the Trent and Moira Rivers are blockages to eel presence upstream. Other rivers, with older dams in poor condition, have more eels upstream. Did logit regression on presence-absence. Eel presence was influenced by water temperature and by the number of impassable dams downstream.

Question: Did proximity to Bay of Quinte (where eels were stocked) influence eel presence?
Response: Analysis did not show this, but common sense would suggest it. Also Bay of Quinte is a warm area.

Question: Any *A. crassus*?
Response: All my eels have been given to Tom Pratt.
Comment: This is for Alastair to answer.

Question: Is the distribution of eels, as shown by these records, being mapped?
Response: Both Ontario and DFO collect information on eel distribution. The Natural Heritage Information Centre should hold this data.

Research into Trap and Transport as a Potential Mitigation Using Traditional Fisheries Methods 2011

David Stanley, Ontario Power Generation, Hydro Business Environment Division, Niagara-on-the-Lake, Ontario

Abstract

The OPG Action Plan for Offsetting Turbine Mortality of American Eel at the R.H. Saunders Generating Station (GS) proposed a research program to investigate the economics and practical feasibility of a trap and transport system as an option for mitigating turbine mortality at the Saunders GS during the downstream migration of mature silver eels. The trap and transport mitigation would involve the use of traditional fisheries methods to efficiently capture large numbers of migratory eels for transport around the generating stations resulting in increased escapement from the St. Lawrence River.

The capture of silver eels in the Upper St. Lawrence River-Lake Ontario (USLR-LO) and L. St. Francis has proven problematic and costly. Experimental studies by the New York Power Authority (NYPA) from 1998 – 2000 found that despite intensive efforts, no more than 152 silver eels could be captured upstream of the Saunders-Moses GS at a cost of thousands of dollars per eel. However, a large fishery for yellow eels previously existed in the USLR-LO and L. St. Francis prior to 2003 when eels in Lake Ontario were more abundant and commercial fishers

still fish for other species in these waters. Due to the difficulty in collecting silver eels, a decision was made in 2008 to investigate the feasibility of substituting large yellow eels that would likely mature to silver eels within a few years and was approved by the OPG Action Plan Executive Committee.

The large yellow eels are collected by paying existing commercial fishers a reward for large yellow eels taken as by-catch during their normal fishing activities. The 2011 study built on results from 2008 to 2010 to further examine the feasibility of capturing large yellow eels (pre-silvering stage) in sufficient numbers in the USLR-LO and L. St. Francis to support a trap and transport strategy; determine the feasibility and related mortality of capturing, holding and transporting large yellow eels downstream of Saunders and Beauharnois GSs to Lac St. Louis; and to examine if the subsequent mortality, growth, health, condition, maturation and migration of transported large yellow eels is adversely affected.

Large yellow eels (minimum size greater than 80 cm or approximately 2.5 lb) were caught by commercial fishers in the USLR-LO upstream of Saunders and L. St. Francis. In the USLR-LO, 11 commercial fishers caught 252 large yellow eels as by-catch. The L. St. Francis fishery consisted of two licenses and 1,475 eels were captured that met the size criteria. Fishing started in early April and ceased June 30, 2011. Commercial fishers were compensated $25 per eel from L. St. Francis and $50 per eel from USLR-LO. Due to low catches above Saunders GS the bounty for eels was increased in 2010 to stimulate interest by the fishers and potentially increase catches.

A total of 1622 eels were transported and released to Lac St. Louis (1370 from L. St. Francis and 252 from USLR-LO). A reference sample of 105 eels were released back into L. St. Francis to compare against those transported downstream. During the release program, all the eels were observed to be in good health and swam away from the release site.

Discussion

Question: How are the numbers of eels "saved from turbine mortality" calculated? Response: 40% of eels leaving Lake Ontario are killed in turbines (through 2 hydro dams). 18% of eels leaving Lake St. Francis are killed in turbines (through 1 hydro dam) Value of program is not only in the number of eels saved but in learning about technique of transferring fish – they do appear to migrate as if they matured naturally.

Infrasound Studies

Jean Caumartin, Hydro Quebec, 75 Boul Rene Levesque Ouest Montreal, QC

Abstract

No abstract provided for this presentation

Discussion

Plan to complete the experiment during 2011 before deciding on future experiments. Irish experiments are being done as a proof of concept

St- Pierre et Miquelon eel fishery

Julien Preynat

Abstract

No abstract provided for this presentation

Discussion

Has size distribution data. Has not looked at the sex distribution.

Exploitation rates in the silver eel commercial fishery following licence buyout in the St. Lawrence estuary

Guy Verreault, Ministère des Ressources naturelles et de la Faune, QC

Abstract

No abstract provided for this presentation

Discussion

Exploitation rate in 1996-7 was 21%, now less than ½ of that
Has not been able to identify a marker that can distinguish Lake Ontario eels

Lake Ontario abundance indices

Alastair Mathers, Ontario Ministry of Natural Resources, Glenora Fisheries Station, RR 4, Picton, ON, K0K 2T0.

Abstract

Several long-term indices of abundance of American eel in the upper St. Lawrence River and Lake Ontario are available. Counts of small yellow eel

climbing the eel ladder at Moses-Saunders Power Dam are available from 1974 to present. In addition, counts of dead silver eels observed in the tail waters of the Moses-Saunders Power Dam 2000 to present. Both of these data sets are described in other presentations at this meeting. Catch of yellow eels in bottom trawls in the Bay of Quinte (eastern Lake Ontario) are available for 1972 to present. No eels have been observed in the 468 trawls conducted since 2002. Catch of larger yellow eels is also available from the boat electrofishing conducted by Dr. J. Casselman annually at Main Duck Island (eastern Lake Ontario) from 1984 to present. This year 5 eels (preliminary CUE is 0.536 +/- 0.636 eels per hr) were captured during night time surveys – all are assumed to have originated from the stocking program. It should be noted that of the 100 eels sampled during the electrofishing survey at the Mallorytown Landing site, 3 fish contained *Anguillicoloides crassus*. This is the first confirmed observation of this swimbladder parasite in the St. Lawrence River system. Correlations with various time lags were used to examine relationships between these data sets. It was found that the eel ladder data with a 4-yr lag was correlated with the trawling data (r=0.79). For the electrofishing data, the eel ladder data with a 5-yr lag was the strongest correlation (r=0.89). The tailwater data and the eel ladder data with a 12-yr lag were also strongly correlated (r=0.74). These lags fit with our understanding of the life history of eels in this system. Estimates of silver eel abundance were developed based on these trend-through-time data series (with time lags) and scaled to match the abundance of silver eels leaving the system during 1996-97 (Verreault and Dumont, 2003). This model suggest that there are currently less than 2,210 silvers coming from USLR-LO system and that numbers will stay low for the next few years. This model is based on natural migrant eels only and does not include numbers of stocked eels that mature into silvers and leave the system

Discussion

Comment: How many people are surprised that *A. crassus* is now present?

Question: Can you know what year it was stocked?
Response: Can't say where it was from. Congener for life-stage, for example goby could have been a vector. Low abundance of parasite indicates a low background level. Could be tested genetically, but this did not work for goby.

Question: Several eels, only one parasite each, does that imply a local infection?
Response: Don't know. Don't multiply in fish. If it was heavily infected then environment would have more.

Comment: Despite 1000's of eels being processed only the stocked eels contain the parasite.

Comment: Trade of live eels in Toronto could have introduced the parasite

Comment: The more likely hypothesis is that it originated from stocking.

Comment: Has been picked up in areas where there is no stocking. Stocked eels are the only ones in the system now, so a local infestation (not stocking) can't be discounted

Question: Why take the risk and stock more eels
Response: No decision has been made with respect to future stocking

Comment: What % infection would it take to stop stocking? Not a big benefit from stocking eels. High likelihood that they were introduced by stocking. Right now, according to NY, it is a game-stopper.

Comment: Decision on stocking has not been science-based and process was not transparent and inclusive. All the stakeholders need a voice and need all the information. OCFA has been opposed to stocking and has been shut out of the process. Because of the risk of parasite introduction, stocking was discontinued by Quebec and will not be continued.

Are chemical contaminants contributing to the recruitment failure of American eel (*Anguilla rostrata*)?

Peter V. Hodson[1], Sharilyn Kennedy[1], Cyril Rigaud[2], Catherine M. Couillard[2], John Casselman[1], Claude Belpaire[3]
[1]Queen's University, Kingston ON,
[2]Fisheries and Oceans Canada, Mont-Joli QC,
[3]Research Institute for Nature and Forest, Groenendaal-Hoeilaart, Belgium

Abstract

One possible cause of the decline of recruitment of American eel (*Anguilla rostrata)* to L. Ontario since the 1980s is embryotoxicity of dioxin-like compounds (DLCs). Eels in L. Ontario accumulate DLCs to the same extent as lake trout (*Salvelinus namaycush*), and trout reproductive failure has been tied to DLC accumulation, among other factors. The eel is semelparous, reproducing once after a 6-mo migration from L. Ontario to the Sargasso Sea, during which feeding stops, tissues are catabolized to sustain migration and oocyte maturation, and lipid stores (20-30% ww) are transferred to oocytes, along with lipid-soluble contaminants. Thus, embryotoxicity and lower recruitment may result from maternally-derived DLCs. The extended life cycle of eels means that juveniles recruiting to L. Ontario in the 1980s - 90s were spawned from parents that integrated the contaminant history of L. Ontario from the 1960s - 70s, the period of highest contamination. We report that contaminants extracted from L. Ontario eels captured in 1988 and 1998 and archived in frozen storage were embryotoxic when injected into the eggs of mummichog (*Fundulus heteroclitus*). However,

extracts from eels captured in 2008 were not toxic to embryos of mummichog or Japanese medaka (*Oryzias latipes*). Spatially, extracts of eels captured in 2008 from other locations on the St. Lawrence River and estuary, and from Gaspe and Maritime rivers, were also non-toxic, in contrast to extracts of Hudson R. eels and European eels (*Anguilla anguilla*) from a highly contaminated site in Belgium.

Discussion

Question: What other contaminants should be looked at?
Response: Work is not complete. In the process of publishing this work

Comment: The effect of a relationship between age and length and contaminants is avoided by choosing 20 yr old

Question: How does this fit into panmixia?
Response: Difficult to accept hypothesis, eels in L Ont contribute large fraction of population. Assumes decrease in recruitment is equal across all streams, this may not be true.

Question: Body burdens of round goby for these chemicals?
Response: Shift in how energy is transferred to top predators. Round Gobies established in food web in St Law R. may transmit contaminants into food web faster. Don't think this has been documented. Theory is that gobies transmit contaminants into the food web more quickly

Question: Why focus on last 5 yrs of life span?
Response: Because eels put on lots of weight at this stage of maturity. May accelerate at end of life... L Ont: live longer and get bigger so they accumulate more. Stocked eels would be different (less)

Spatial and temporal trends in contaminants in eels

Mehran Alaee, Environment Canada, 867 Lakeshore Road, Burlington, ON, L7R 4A6

Abstract
No abstract provided for this presentation

Discussion

Probably silvering eels as indicated by lipid %, all temporal data is L.Ont ~20yrs old. PBDE may reflect change in food web and change in time in L Ont
Stable isotope data fascinating, shows carbon changes in energy flow (2008) consistent with goby & zebra mussel consumption.

Question: Mirex: was detected in Riv. Sud Ouest eels? Want to know which proportion from Gr. Lks or Quebec area.
Response: Not sure – need to check

Comment: Individual eels showed different results than the mean, might be from different sources. PCBs and Dioxins reduced but lots of other contaminants. Removing of these does not remove the problem (related to recruitment) what else is out there? Would like to reference this in Recovery Strategy (see Jonathan Byers reports/proceedings). PBDE levels of eels at lower level than L. Trout. Might have to do with residency time in L Ont and changes in food web.

Question: Could mirex be used to distinguish eels from Lake Ontario from others from the SLR system?
Response: Mirex is getting so low in Lake Ontario that is close to the detection limit and these data are highly variable

Comment: It is good to see that contaminants are declining in general, but we should not think that this will mean that eels will recover without effort

Contaminants in eels

John Fitzsimons Department of Fisheries and Oceans, Bayfield Institute, 867 Lakeshore Road, Burlington, ON, L7R 4A6

Abstract

No abstract provided for this presentation

Discussion

Thiamine deficiency may surpass contaminants effects

Question: Sensitivity of eel to thiaminase in alewife?
Response: Thiamine in diet may be nixed by thiaminase in alewife. Mortality begins around 1 pico moles same as lake trout

Question: Concern of storage for stable isotopes?
Response: Frozen so not a concern for formaldehyde

Eel artificial maturation and relationship between maternal and egg contaminant levels

Ken Oliveira, University of Massachusetts Dartmouth • 285 Old Westport Road • North Dartmouth, MA, 02747-2300

Abstract

The recent decline in worldwide populations of Anguillid eels is thought to be caused by pollution, overfishing, climate change, and/or habitat destruction. American eels, *Anguilla rostrata,* are known to inhabit contaminated rivers for the majority of their lives until they migrate to the ocean to spawn. Due to their unique catadromous life cycle, mature adults are not accessible for study and little is known about the effects of contaminants on fertilization and larval development. Using methods similar to the maturation of *Anguilla japonica*, *A. rostrata* males and females were artificially matured with weekly hormone injections. Using these procedures, our objectives were to (1) examine the maternal transfer of environmental contaminants to the eggs, (2) examine the effects of contaminant load on the fertility of females, and (3) examine the effects of polychlorinated biphenyls (PCBs) on the reproductive success of male eels. To examine the maternal transfer of contaminants to the eggs, ovulated eggs and muscle tissue are being analyzed for PCBs, dioxins and furans, pesticides, polybrominated diphenyl ethers, and metals. Results, to date, provide important baseline data and will facilitate development of a model for predicting parental contaminant contribution to offspring. To examine the effects of contaminant load on the reproductive potential of females, time to full maturation, ovulation, and fertilization success were evaluated and will be compared to the contaminant load in eggs. To examine the effect of PCBs on male gametogenesis, fertilization, embryogenesis and early larval development, males were co-injected with 2 different concentrations (1.0 or 10 µg/fish) of PCBs. Fertilization success and embryogenesis were assessed 2-4 hours post fertilization (PF), 24 hours PF, and 48 hours PF. Preliminary results show that males injected with 10 µg of PCBs exhibited lower reproductive success and produced embryos with disrupted early embryonic development. Fertilization success was significantly lower in embryos fertilized with sperm from males injected with 10 µg PCBs compared to the controls. Our results will shed light on whether environmental contaminants are contributing to the decline of *A. rostrata*. These findings will be important for future conservation efforts and the management of the American eel.

Discussion

Question: Any rivers with males that would have high PCB levels?
Response: Yes, not sure which one they are. Hudson is loaded but not easy to get males

Question: Effects of PCB on sperm mobility
Response: Yes, but depends on the PCB congener – to be published

Question: How long to artificially mature a female?
Response: 10-11 weeks for best fertility results but need to maybe adjust dosage based on size.

Question: Does the maturation process mimic natural?
Response: Not sure but confident that this level of maturation cannot happen too early because they can't swim in that state.

Effect of thiamine status on critical swimming performance of American eel

Dale C. Honeyfield and Steve McCormick. US Geologic Survey, Leetown Science Center. Kearneysville, WV, 25430

Abstract

Lake Ontario American eel *Anguilla rostrata* are in decline and the reasons for their decline are not fully understood. John Fitzsimons (DFO Canada) captured Lake Ontario eels in 2005and found low muscle thiamine concentrations. Low thiamine has been shown to adversely affect spawning migration of Coho salmon *Oncorhynchus kisutch* and Rainbow trout *Oncorhynchus mykiss* but the effect of low thiamine on eel swimming performance is unknown. The objective of the present study was to determine the critical swimming performance in laboratory reared eels. Eels were fed either thiamine replete or thiamine deficient diets. Once eels became thiamine deficient, their diet was fortified with 0.4 mg thiamine/kg to prevent morality. Eels were individually placed in the experimental chamber (30.5 cm diameter x 70 cm length) and acclimated at a flow rate of 10 cm/sec. After one hour acclamation, flow was incrementally increased by 10 cm/sec every 20 min until swimming exhaustion was observed. Water temperature was maintained at 18-20 C. Liver and muscle thiamine was determined in samples collected at the end of the swimming period. Eel average weight and length was 33.3 g and 26.6 cm, respectively. Critical swimming speed was 50 cm/sec in thiamine replete, 29 cm/sec in low thiamine treatment and 44 cm/sec in low thiamine eels injected with 5 mg thiamine. Muscle total thiamine in the respective eel groups was 4.5 0.9 and 2.4 nmol/g. Impaired eel swimming due to low thiamine may adversely affect spawning migration to the Sargasso Sea and impact reproduction if migration is delayed.

Discussion

Question: There were lots of alewife in Lake Ontario during 1920's but eels were doing well then...
Response: Prey diversity was higher back then. Alewife represents a higher proportion of the eel diet now

Question: Could the diet of the alewife have an effect on their thiaminase content?

Response: Unknown, but possibly. During 1980s fish hatcheries in NY saw very little effects of thiamine deficiency, but now routinely treat with thiamine – seems like thiamine deficiency has increased

Comment: Thiamine deficiency may disrupt the Krebs cycle. Thiamine deficiency is in part due to a diet rich in alewife. Thiamine deficient eels have a lower Ucrit. 50% of eels leaving Lake Ontario are thiamine deficient.

Question: Is this thiamine deficiency affecting all the Great Lakes?
Response: It is apparently the case.

Question: Could alewife diet affect its thiaminase content? (Thiaminase is the enzyme that dissolves thiamine.)
Response: There is a large variability in thaminase content of various prey species. Goby could potentially be involved in this problem as a new alewife prey species.

Tracking the movements of the American eel in the St-Lawrence River: Project overview and first results

Mélanie Béguer[1], José Benchetrit[1], Martin Castonguay[2], Daniel Hatin[3], Guy Verreault[3], Michel Legault[3], Mélanie Dionne[3], Pierre Dumont[3], Yves Mailhot[3], Jean-François Bourque[4], Valérie Tremblay[4], Julian J. Dodson[1]

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[4]AECOM

Abstract

Abundance of the American eel in the St. Lawrence River has declined drastically since the late 1980's, yet the estuarine and marine portions of the species' life cycle remain largely unknown. This lack of knowledge represents a serious impediment to any meaningful management efforts directed at conserving the species. This project is part of OTN (Ocean Tracking Network), a global initiative concerned with studying movements, migrations and connectivity of highly migratory marine animals. Our project aims at establishing the migration routes followed by both juvenile (yellow stage) and adult (silver stage) eels from the St. Lawrence system to the spawning area as well as identifying the dominant abiotic and biotic conditions that prevail along these routes. To this end, acoustic hydrophones were deployed and set up to form arrays in the upper St. Lawrence and middle estuary in 2010 (4 arrays) and 2011 (10 arrays). Other lines managed

by OTN are currently deployed in Cabot Strait and Canso Strait, and off Halifax, allowing us to follow movements during the marine phase of the migration. Eels (92 in 2010 and 125 in 2011) were tagged with internal acoustic pingers and released in the fluvial section of the St. Lawrence during summer. The project's pilot year in 2010 proved successful given that an important proportion of tagged eels were detected by the acoustic arrays in the St-Lawrence (77% of silver eels and 50% of yellow eels). We observed unidirectional movements for most eels, an increase in individual migration speed with time and an overall decrease in downstream speed. Moreover, most of the silver eels were detected during ebb tide suggesting selective tidal transport. Finally, the majority of yellow eels were detected at a single array suggesting that movements are more restricted at this scale. The acoustic receivers are scheduled to be retrieved in November 2011 and consequently the results for the project's second year are not yet available. Furthermore, 18 silver eels will be equipped with satellite pop-up tags (X-tags, Microwave Telemetry Inc) to determine the entire migratory route towards the spawning site in the Sargasso Sea.

Discussion

Question: Were satellite X-tags installed only on silver eels?
Response: Yes they were.

Question: How were they attached?
Response: Nylon thread through muscle (Japanese technique). Tested in tanks and eels appear to swim normally

Question: Why was a Halifax line installed as it doesn't seem very useful with respect to eel migration?
Response: OTN involves the study of a whole suite of migratory species, not only eels.

Question: How do X-tags work?
Response: Chemical dissolution occurs after a certain number of months in the ocean at which time data are sent to satellites.

Question: You could use OTN to examine various effects with respect to condition. How difficult would it be to measure fat content of eels equipped with pingers? Response: Pierre Dumont says that have developed such methods with lake sturgeon. For thiamine, blood content would need to measured or possibly muscle biopsy (need relationship between blood thiamine and muscle thiamine) Could measure impedance of eels to predict fat content (even if the relationship has not been determined yet.

Timing and duration of American eel spawning migration during pristine (1843-1876) and contemporary (1960-2004) periods in the St. Lawrence estuary

Guy Verreault, Ministère des Ressources naturelles et de la Faune, QC

Abstract

No abstract provided for this presentation

Discussion

Silver eels now migrate 10 days earlier at Rivière Ouelle compared to historical period because upper reaches of the watershed (Lake Ontario) are no longer available for growth.

COMMENT: Somebody warned that the 1850s may not have been pristine because of small dams. Pierre Dumont states that dam development took place at the end of the 19th century, i.e., after the historical period considered here.

COMMENT: Somebody pointed out that the St. Lawrence River warmed by 1°C between the historical and recent periods which could just as well account for the 10-day difference observed between the 2 periods. The author agreed.

A proposed methodology for a comprehensive stock assessment of the American eel.

David Cairns, Department of Fisheries and Oceans, Box 1236, Charlottetown, PEI, C1A 7M8

Abstract

A methodology is proposed to provide the first comprehensive assessment of the panmictic American eel stock, based on the three pillars of habitat quantification, modelling of demographic parameters, and spawner-per-recruit analysis. Growth habitat in marine waters will be mapped on the basis of degree of exposure to the open sea, depth, and temperature regime. Freshwater habitat will be quantified using relations between watershed size and wetted area, and locations of artificial and natural barriers. Densities will be compiled from field measurements or estimated from relations between density and catch-per-unit-effort. In freshwater, densities will be scaled by distance from the sea. Demographic parameters will be compiled from field measurements or modelled from environmental data, using the approach of Velez-Espino and Koops (2010). Demographic models will be created for regions that have relatively homogeneous demographic traits and levels of fishing activity. These models will

use spawner-per-recruit analysis to estimate the reduction in spawn output due to fishing, in relation to spawn output of an unexploited population. The assessment will estimate standing stock by number and biomass, silver eel production and potential egg production, fisheries exploitation rates, and compliance with target and limit biological reference points. The assessment will also identify regulatory regimes which will maximize yield-per-recruit in eel fisheries. These results will be presented for local regions, and aggregated by state/province, management unit, country, and the North American continent. The proposed stock assessment will provide the first robust diagnosis of the American eel's conservation problems, and it will determine the nature and the priority level of measures needed to remedy these problems.

Discussion

David is looking for critiques of proposal and potential partners. Assumes that eel freshwater habitats are limiting. Need to look at the sex ratio of eels generated by different habitats.

Question: How was the extent of the geographic cells determined?
Response: Based on eel demographic data that is available

Comment: Source of information on eels in Puerto Rico is available from a recently published paper – and John Casselman has some too

Update on GIS tool

Carolyn Bakelaar Great Lakes Laboratory for Fisheries and Aquatic Sciences (GLLFAS), Canada Centre for Inland Waters, 867 Lakeshore Road, Burlington, ON, L7R 4A6

Abstract

No abstract provided for this presentation

Discussion

Looking for people to test product, contact Carolyn. Project was seen as valuable and is supported by the group.

Two-Eyed Seeing Approach to Eel Research in the Bras d'Or Lakes

Shelley Denny and Angela Denny , Unama'ki Institute of Natural Resources, Eskasoni, NS

Abstract

The Mi'kmaq of Unama'ki (Cape Breton, Nova Scotia) integrated their cultural values and traditional knowledge and scientific investigation, also known as Two-Eyed Seeing, to learn more about their local eel population. Samples were collected from various sites within the Bras dOr Lakes to obtain an average picture of the population (length, weight, ages, stage of maturation, and stomach content observations) and to determine the distribution and intensity of the swimbladder parasite *A. crassus* within this area. From the traditional perspective, workshops, interviews and time spent learning from Mi'kmaq eel fishers were methods used to gather knowledge on current fishing practices, habitats, state of the population, uses, value and traditional management.

Discussion

Males may not be represented in the catch because spearing tends to select larger (female) fish. Mass mortality (100s) of eels observed in 2 communities. Unclear what was the cause of death – only eels were observed. Near one of the locations there is a gypsum processing / shipping plant. Shape of eels heads is thought to be a predictor of sex – pointier heads tend to be male. Traditional use of skins is for sore joints, but also crafts. This community is very interested in sharing information.

Assessment Of American Eels In Atlantic Canada's National Parks

Plummer, A and D. Austin. Fundy National Park, P.O. Box 1001 Alma, NB, E4H 1B4

Abstract

With the decline of American Eels (*Anguilla rostrata*) in the Upper St. Lawrence River-Lake Ontario region and resulting Special Concern designation by COSEWIC, there has been renewed interest in determining the status of eels in Atlantic Canada. Targeted sampling in freshwater and estuarine habitats was undertaken in five Maritime national parks. Initially, we attempted to estimate the number and timing of the movement of elvers (juvenile stage) from the marine to freshwater environments. Sampling techniques have included 3 trap designs (ramp, habitat & Sheldon) and night dip-netting, all with relatively low capture success. Determining the timing of the elver run is difficult given the small catches, however, preliminary results suggest that the timing may vary for each park, depending on geographic location. Despite low numbers of elvers, observations from electrofishing, rotary screw trap and eel pot operations suggest that adult eels are relatively common in all five parks. This coupled with low catches of elvers may suggest that the trapping techniques are ineffective, or that there are very small numbers of elvers entering our parks. It remains

uncertain whether either of the aforementioned factors or a combination of the two is responsible for our lack of success. However, after 4 years of sampling with a variety of techniques, we have greater confidence that sampling technique is likely not the problem. Therefore, given difficulties in estimating recruitment via the elver life stage, we have recently shifted our focus to the adult life-stages, examining abundance and distribution from estuary to headwaters.
Elver and yellow eel sampling in National Parks in Atlantic Canada

Discussion

www.americaneel.ca : This website is a collaborative effort between Parks Canada, the Atlantic Cooperative Study Unit, Acadia University, and the Aboriginal Community of Atlantic Canada

Question: What is the mesh size in the fyke nets used for elvers?
Response: Smaller than "screen door" mesh

Question: How is ATK used?
Response: Group with representatives from First Nations provides advice to federal partners

Comment: Fundy was the only location where dip netting of elvers was successfully used – it was tried at a couple of other parks with no success.

East River elver project

Genna Carey, Yvonne Carey, and Lydia Stephens-Scotia-Fundy Elver Advisory Committee

Abstract

No abstract provided for this presentation

Discussion

Comment: Surprised to hear how abundant elvers were at East River... poor year in other locations
Response: Shows how variable recruitment can be

Ramps are moved depending on the water levels. Prediction for good year for elvers in Maine and Fundy based on how close the Gulf Stream was to the coast.

Appendix 1
(Agenda for the meeting)

29	3:30 PM	New York Hydro Relicensing Update	Steve Patch (USFWS)
29	3:40 PM	Lake Ontario abundance indices	Alastair Mathers (OMNR)
29	3:55 PM	Exploitation rates in the silver eel commercial fishery following licence buyout in the St. Lawrence estuary	Guy Verreault (QMRNF)
29	4:10 PM	General Discussion/Remaining items	Geoff Veinott and Tom Stewart
29	4:30 PM	Wrap-up and adjorn	Geoff Veinott and Tom Stewart
29	6:00 PM	Dinner at The Casa de Mateo Restaurant	
SCIENCE SESSION - DAY 2			
30	8:30 AM	Housekeeping items/logistics	Geoff Veinott and Tom Stewart
30	8:35 AM	Are chemical contaminants contributing to the recruitment failure of American eel (*Anguilla rostrata*)?	Peter Hodson (Queens Univ.)
30	9:00 AM	Spatial and temporal trends in contaminants in eels	Mehran Alaee (EC)
30	9:20 AM	Contaminants in eels	John Fitzsimmons (DFO)
30	9:40 AM	Eel artifical maturation and relationship between maternal and egg contaminant levels	Ken 'Oliveira (Univ Mass)
30	9:55 AM	Effect of thiamine status on critical swimming performance of American eel	Dale C. Honeyfield and Steve McCormick (USGS)
30	10:15 AM	Break	
30	10:45 AM	Ocean Tracking	Melanie Beguer / Hatin/Castonguay
30	11:05 AM	Timing and duration of American eel spawning migration during pristine (1843-1876) and contemporary (1960-2004) periods in the St Lawrence estuary	Guy Verreault (QMRNF)
30	11:25 AM	Stock Assessment Method	David Cairns (DFO)
	12:05 PM	Lunch	
30	1:05 PM	Update on GIS tool	Carolyn Bakelaar (DFO)
30	1:35 PM	Two-eyed Seeing Approach to Eel Research	Shelly Denny (UINR)
30	1:55 PM	Elver and yellow eel sampling in National Parks in Atlantic Canada	Deborah Austin and Alana Plummer (Parks Canada)
30	2:15 PM	East River elver project	Yvonne Carrey, Genna Carrey and Lydia Stephens (FEAC)
	2:35 PM	Dual Frequency Identification Sonar (DIDSON) as a potential tool for monitoring eel movements in a river	Geoff Veinott (DFO)
30	2:40 PM	General Discussion and Wrap-up	Geoff Veinott and Tom Stewart
30	3:00 PM	Adjourn	

Appendix 2
List of Attendees

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